

Analysis of the Preventative Influence of an Oral Hygiene Protocol on Ventilator-Associated Pneumonia

Análise da Influência Preventiva de um Protocolo de Higiene oral na Pneumonia Associada à Ventilação Mecânica

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Abstract

Ventilator-associated pneumonia (VAP) is the most commonly reported nosocomial infection among intensive care unit (ICU) patients. This study aimed to evaluate the influence of an oral hygiene protocol on VAP incidence among mechanically-ventilated (MV) ICU patients. The dentate patients admitted without VAP to the hospital's adult ICU requiring mechanical ventilation for ≥ 48 hours during a 4-month period in two consecutive years (2015 – Control group and 2016 – Experimental group) were included in this investigation. The oral hygiene protocol was implemented daily, once a day, in the morning hours, using a disposable brush with suction and ultrasoft bristles and 3 g of 0.12% chlorhexidine gel. Hospital-related respiratory infection data, including VAP diagnoses and microbiological analyses, were collected from the monthly health epidemiological notification bulletins issued by the hospital. T tests were applied to compare variables before versus after implementation of the oral hygiene protocol with a significance criterion of $P < .05$. 43.94% reduction in VAP rate after the protocol implementation was observed. Implementation of the protocol was associated with a significant reduction of *Enterobacter spp* infections and no cases of VAP related to the main etiological agents of the disease (i.e., *S. aureus* and *C. albicans*) were identified. It can be concluded that an oral hygiene protocol performed with a suction brush and 0.12% chlorhexidine gel can serve as an effective prophylaxis against VAP in patients under mechanical ventilation.

Keywords: Intensive Care Units. Disease Prevention. Oral Hygiene.

Resumo

A pneumonia associada à ventilação (PAV) é a infecção nosocomial mais comumente relatada em pacientes de Unidade de Terapia Intensiva (UTI). Este estudo teve como objetivo avaliar a influência de um protocolo de higiene bucal na incidência de PAV entre pacientes sob ventilação mecânica (VM). Os pacientes dentados internados na UTI adulta do hospital sem PAV e que necessitaram de ventilação mecânica por ≥ 48 horas durante um período de 4 meses em dois anos consecutivos (2015 - grupo Controle e 2016 - grupo Experimental) foram incluídos nesta investigação. O protocolo de higiene bucal foi implementado diariamente, uma vez ao dia, nas primeiras horas da manhã, utilizando-se escova descartável com cerdas de sucção e ultramacia e 3 g de gel de clorexidina a 0,12%. Dados de infecção respiratória relacionada ao hospital, incluindo diagnósticos de PAV e análises microbiológicas, foram coletados dos boletins mensais de notificação epidemiológica de saúde emitidos pelo hospital. Testes t foram aplicados para comparar as variáveis antes e após a implementação do protocolo de higiene bucal com um critério de significância de $P < 0,05$. Observamos uma redução de 43,94% na taxa de PAV após a implementação do protocolo. A implementação do protocolo foi associada à uma redução significativa das infecções por *Enterobacter spp* e não foram identificados casos de PAV relacionados aos principais agentes etiológicos da doença (isto é, *S. aureus* e *C. albicans*). Pode-se concluir que o protocolo de higiene bucal realizado com escova de sucção e gel de clorexidina a 0,12% pode servir como uma profilaxia efetiva contra a PAV em pacientes sob ventilação mecânica.

Palavras-chave: Unidade de Terapia Intensiva. Prevenção de Doenças. Higiene Bucal.

1 Introduction

Ventilator-associated pneumonia (VAP) is the most commonly reported nosocomial infection among intensive care unit (ICU) patients^{1,2}. Several studies have shown that 24 hours after admission to the ICU, patients can be colonized with various pathogens, including *Pseudomonas spp.*, *Acinetobacter spp.*, *Staphylococcus aureus*, and *Candida albicans*³⁻⁶. These patients are at particular risk of

oropharynx colonization because they are exposed to endemic environmental pathogens and multiantibiotic regimens while, in many cases, having compromised protection of the buccal mucosa, due to reduced salivary secretion and immunoglobulin A levels, compounded by buccal mucosa dehydration caused by the mouth being left open and the accumulation of secretions as a result of intubation and the unique environment created by the orotracheal tube^{2,7}. This study aimed to evaluate the influence of an oral hygiene

protocol on VAP incidence among mechanically-ventilated (MV) ICU patients.

2 Material and Methods

The study was conducted in a private hospital, Hospital do Coração de Londrina, in Londrina, Paraná, Brazil. All dentate patients admitted without VAP to the hospital's adult ICU (50 beds) requiring mechanical ventilation for ≥ 48 hours during a 4-month period in two consecutive years (March to July of 2015 and 2016) were potentially eligible for inclusion in this investigation. The 2015 group of patients served as the non-oral hygiene protocol control group, and the 2016 group of patients were the oral hygiene protocol experimental group. This study was approved by the Committee of Ethics in Research of Hospital do Trabalhador (No: 1,616,844).

The oral hygiene protocol below was implemented daily, once a day, in the morning hours, using a disposable brush with suction and ultrasoft bristles (special care model, Dentalclean, Rabbit Ind. Prods. Hig., Ltda, Londrina, Paraná, Brazil) and 3 g of 0.12% chlorhexidine gel (Dentalclean, Rabbit Ind. Prods. Hig., Ltda, Londrina, Paraná, Brazil).

2.1 Protocol

1. Aspirate oral secretions.
2. Brush teeth and tongue with a suction brush and 0.12% chlorhexidine gel.

For free surfaces, place bristles at 45° relative to the long dental axis, towards marginal gingiva, applying light pressure with vibratory movements.

For occlusal/incisal surfaces, position bristles perpendicular to these faces, applying slight pressure with short anteroposterior movements. In both, brush teeth posterior-to-anterior under suction.

For the tongue, place bristle perpendicular to the surface, applying light pressure with short posteroanterior movements.

3. Clean labial, jugal, palatal, lingual, and buccal mucosa membranes with gauze and 0.12% chlorhexidine gel, applying light pressure in the posteroanterior direction.

4. Irrigate with 10 ml of normal saline (0.9% NaCl).

5. Conduct a final aspiration.

Hospital-related respiratory infection data, including VAP diagnoses and microbiological analyses, were collected for cases managed during the 2015 and 2016 experimental periods from the monthly health epidemiological notification bulletins issued by the hospital and compared between the 2015 and 2016 cohorts. VAP rate was calculated according to the following formula²:

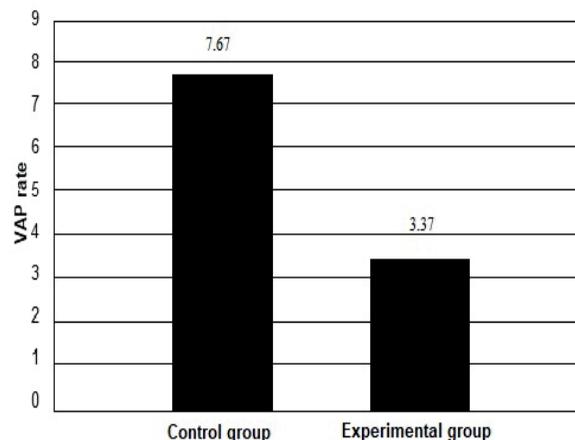
$$\text{VAP rate: cases of VAP / days of ventilation} \times 1000$$

Data were analyzed in Statistica 7.0 for Windows 7.0 (StatSoft, Inc. Tulsa, OK). T tests were applied to compare variables before versus after implementation of the oral hygiene protocol with a significance criterion of $p < .05$.

3 Results and Discussion

As shown in Figure 1, relative to before the oral hygiene protocol was implemented, a 43.94% reduction in VAP rate after implementation of the protocol was observed (2015 control group vs. 2016 experimental group, $p < .001$).

Figure 1 - VAP rate after implementation of the protocol (Control group vs. Experimental group).



Source: Research data.

The microbiological analysis results are reported in Table 1.

Table 1 - Microbiological analysis

| Pathogens | Control group | Experimental group | P |
|-------------------------------|---------------|--------------------|--------|
| | Mean (SD) | Mean (SD) | |
| <i>Acinetobacter spp</i> | 1,00 (0,71) | 0,50 (0,50) | 0,356 |
| <i>Enterobacter spp</i> | 1,50 (0,50) | 0,50 (0,50) | 0,049* |
| <i>Klebsiella spp</i> | 1,50 (0,50) | 1,25 (0,83) | 0,670 |
| <i>Pseudomonas aeruginosa</i> | 0,75 (0,43) | 0,50 (0,50) | 0,536 |
| <i>Staphylococcus aureus</i> | 0,50 (0,50) | 0,00 (0,00) | 0,133 |
| <i>Candida albicans</i> | 0,25 (0,43) | 0,00 (0,00) | 0,355 |

SD: standard deviation

* Statistically significant difference at $P < 0.05$ level.

Source: Research data

This study demonstrated that implementation of an oral hygiene protocol consisting of oral cleaning with suction, a mechanical action, applied together with 0.12% chlorhexidine, a chemical action, provided an effective means of preventing VAP significantly in MV patients in the ICU. The present findings, which are consistent with the findings of Hutchins et al.², Mori et al.⁵, and Fields⁶, are clinically important because they confirm that dental plaque and other oral cavity components serve as reservoirs for pathogenic microorganisms^{1,2,4,6,8-10}. A daily oral hygiene protocol may thus reduce VAP and mortality in MV patients by stifling pathogen growth in these reservoirs. Additionally, because VAP extends ventilation time and, consequently, length of hospitalization, the implementation of such a protocol can have a direct impact is hospitalization costs^{2,8}.

Reduced VAP risk and incidence in MV patients is

likely consequent to reduce or eliminate major VAP-causing pathogens⁵. The main pathogens found to be associated with MV-associated infection in our patients, namely *Acinetobacter spp.*, *Enterobacter spp.*, *Klebsiella spp.*, *Pseudomonas aeruginosa*, *S. aureus*, and *C. albicans*, are consistent with prior reports^{1,5,8-10}. In particular, the implementation of our oral hygiene protocol yielded a significant reduction of *Enterobacter spp.* presence, whereas significant effects on *S. aureus* and *C. albicans* pathogens, important causative agents in VAP etiology^{5,9}, were not established.

The main limitations of this study were a lack of information on comorbidities that could affect VAP rate and non-examination of medication use. Notwithstanding, based on the present results, it can be concluded that an oral hygiene protocol performed with a suction brush and 0.12% chlorhexidine gel can serve as an effective prophylaxis against VAP in patients under mechanical ventilation.

4 Conclusion

It can be concluded that an oral hygiene protocol performed with a suction brush and 0.12% chlorhexidine gel can serve as an effective prophylaxis against VAP in patients under mechanical ventilation.

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